A New Partnership Between the NRCS and the CCSS

or

NRCS Soil Science Division Staff
Assist with Digging Holes and Installing Sensors

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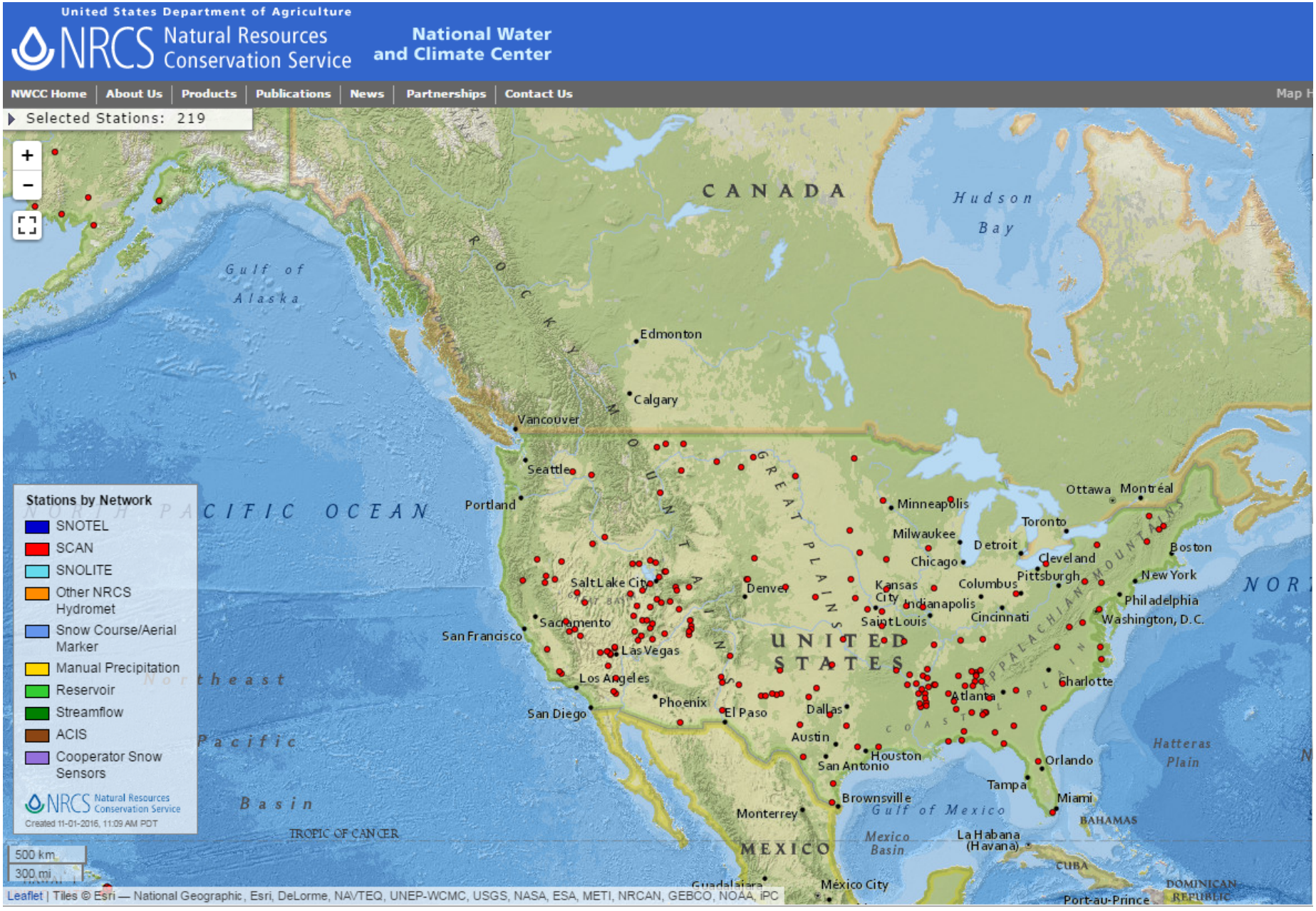
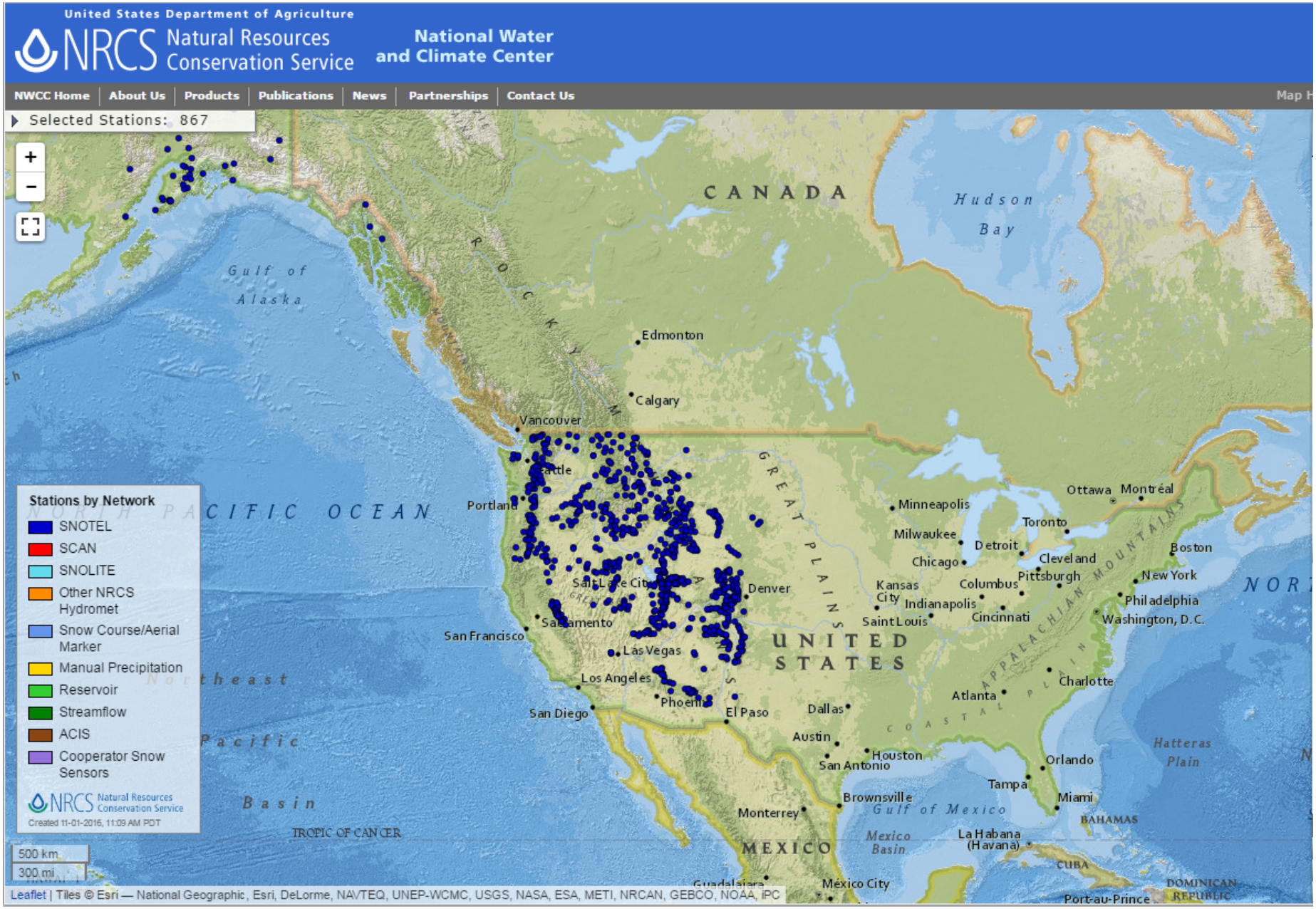
Talk Outline

1. Soil Climate
   - Soil Climate Sensor Networks
   - An Idea
   - Soil Climate Data
2. Soil–Water Interaction
   - Key Soil Properties
   - Soil Water Storage / Availability
3. The Soil Resource
   - Soil Survey
   - SSURGO
   - Future of Soil Survey

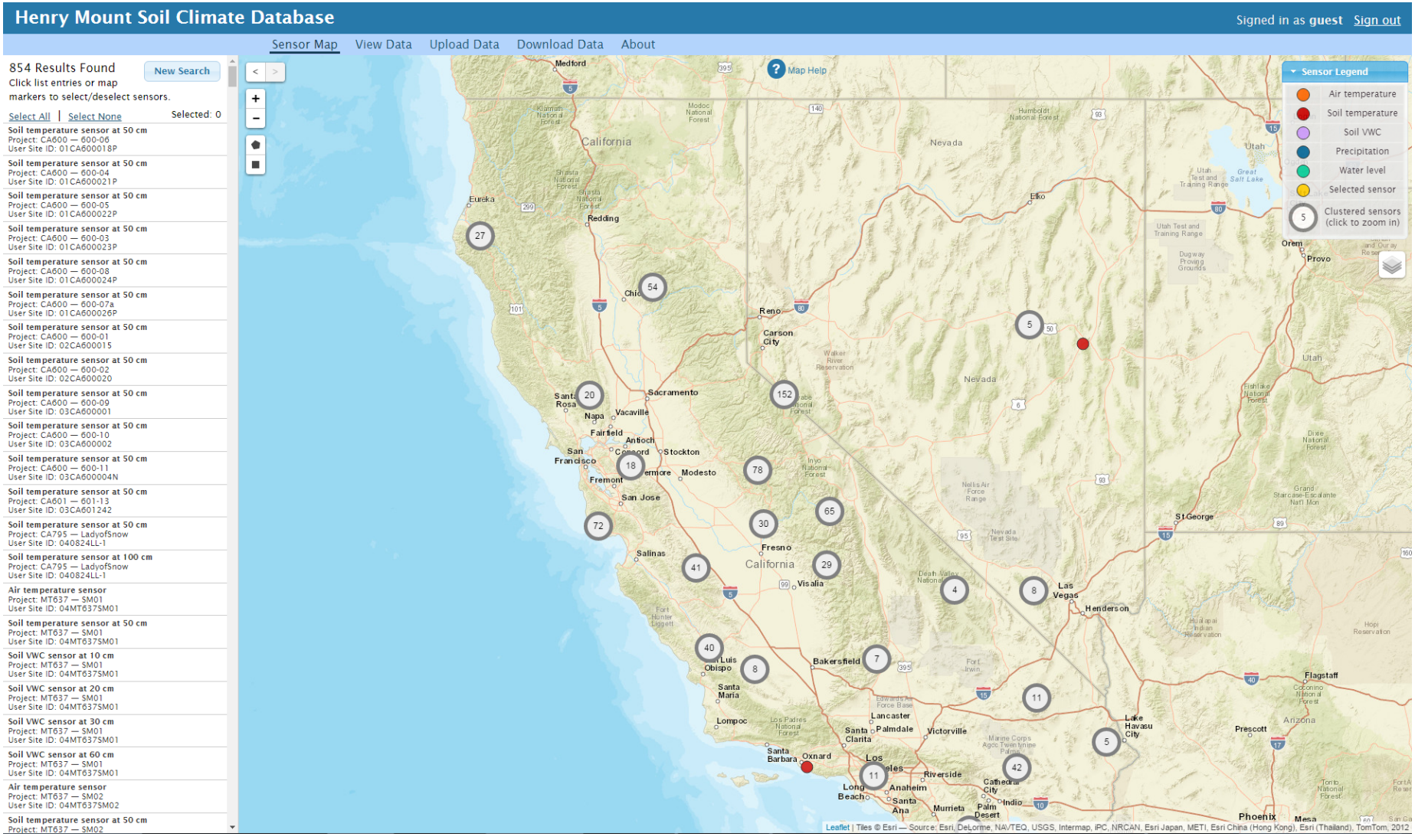
Soil Climate Sensor Networks: SCAN



Soil Climate Sensor Networks: SNOTEL



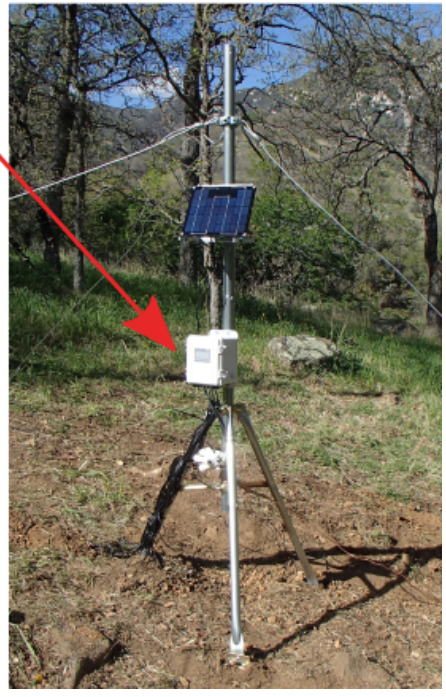
Ad Hoc Sensor Data: Henry Mount Soil Climate DB



Ad Hoc Sensor Data

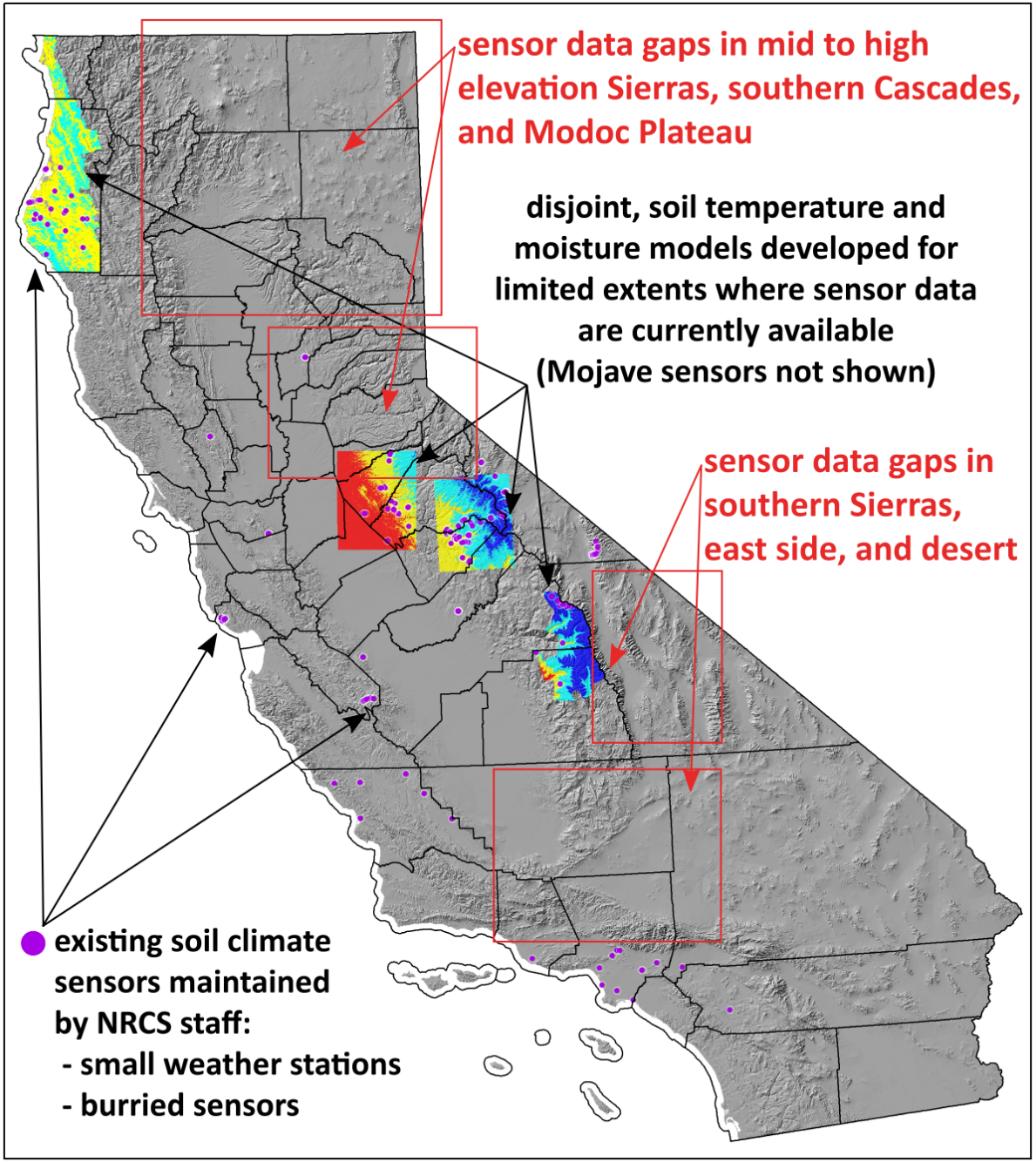
most sensors are installed
at 50 cm depth and require
re-excavation every 2-5 years
to replace batteries
and download data

weather stations require
manual data download



Ad Hoc Sensor Data

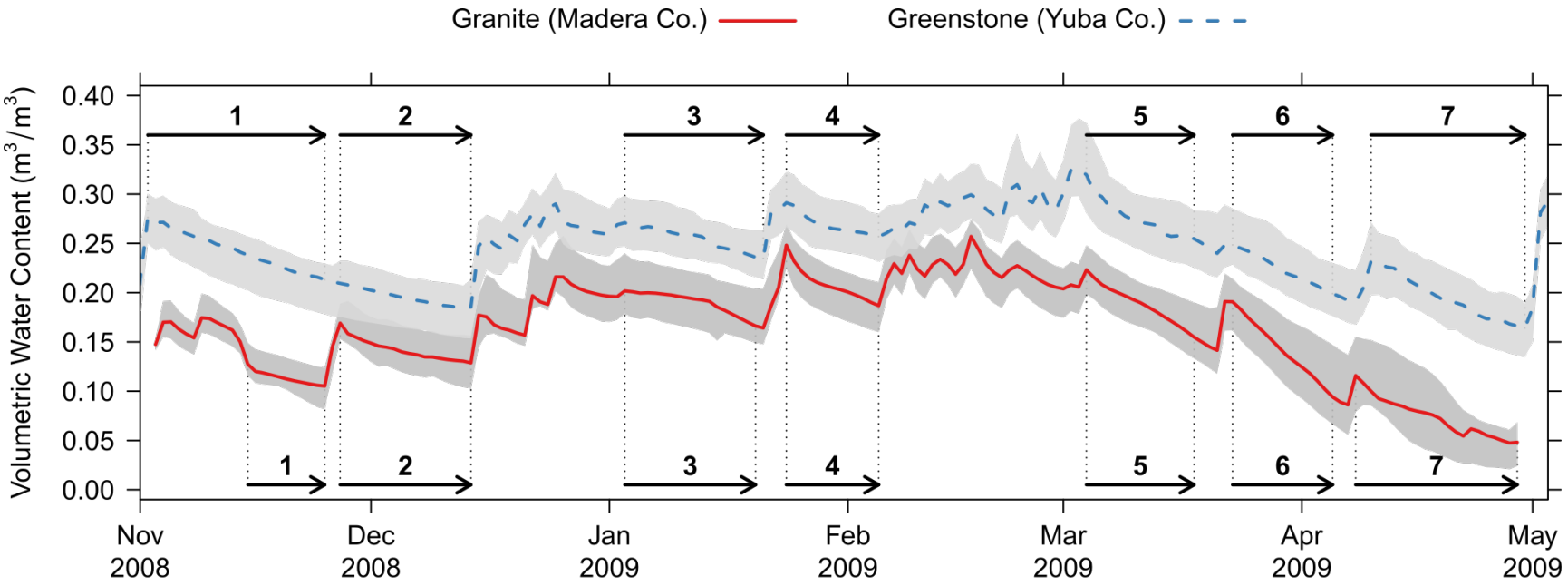
Why am I Here?

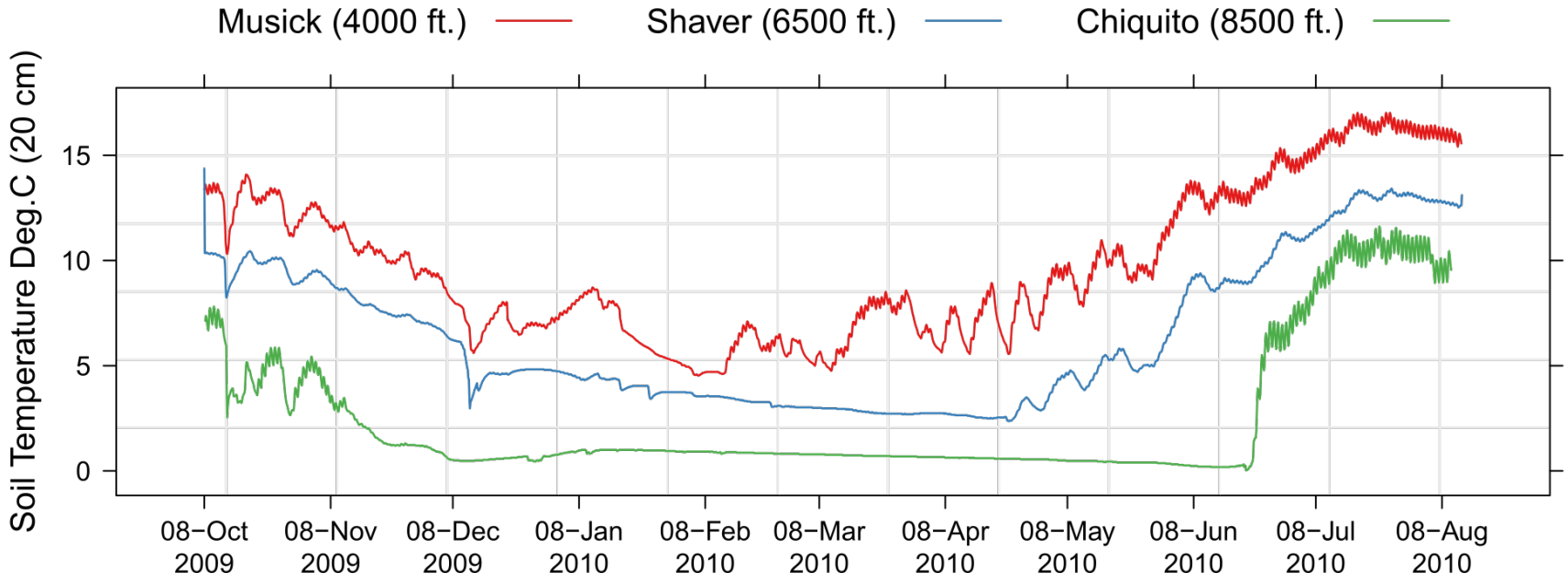

sensor data gaps in mid to high elevation Sierras, southern Cascades, and Modoc Plateau
disjoint, soil temperature and moisture models developed for limited extents where sensor data are currently available (Mojave sensors not shown)
sensor data gaps in southern Sierras, east side, and desert
existing soil climate sensors maintained by NRCS staff:
- small weather stations
- burried sensors

A New Idea: DWR Collaboration

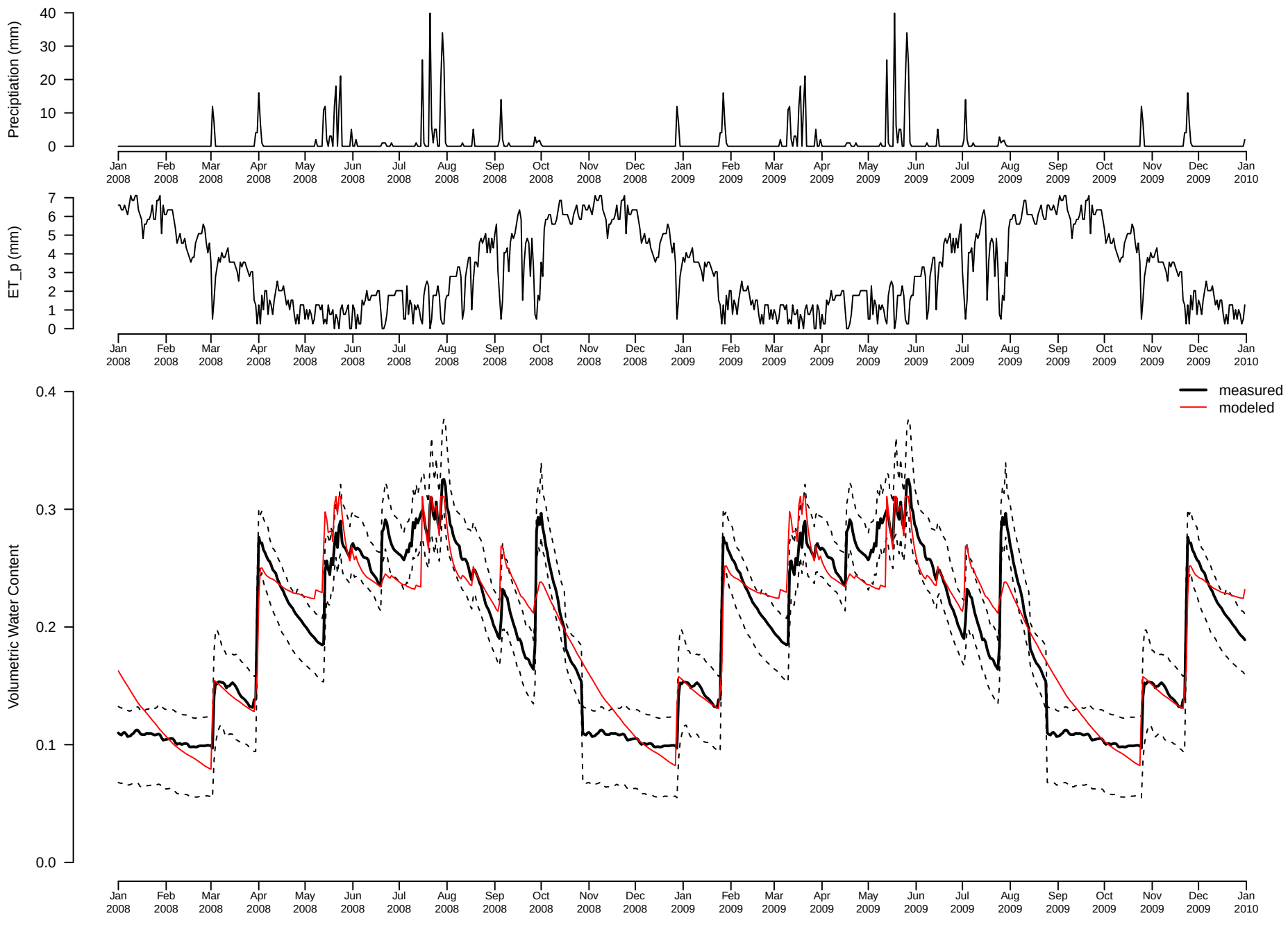
A New Idea: DWR Collaboration

Soil Climate Data





More Effective Prediction: Above/Below Ground Sensors



Soil Properties Relevant to Hydrologic Modeling

Physical Properties

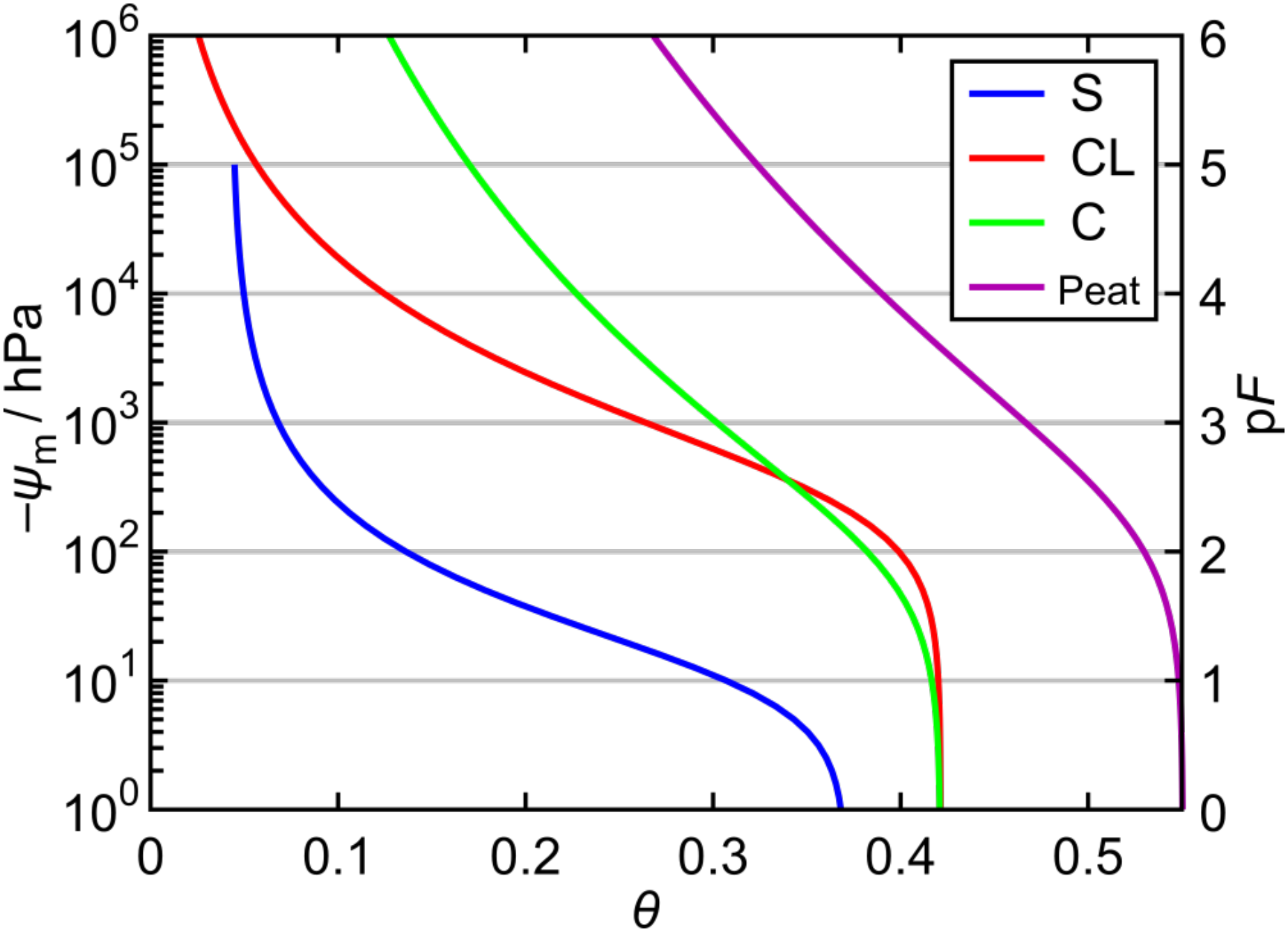
- texture $\rightarrow$ quantity and nature of pore-space $\rightarrow$ water retention
- coarse fragment content $\rightarrow$ rocks displace water
- soil structure $\rightarrow$ macroporosity controls saturated flow
- soil depth $\rightarrow$ more soil $=$ more water storage
- instantaneous soil moisture $\rightarrow$ saturated vs. unsaturated flow

Landscape Context

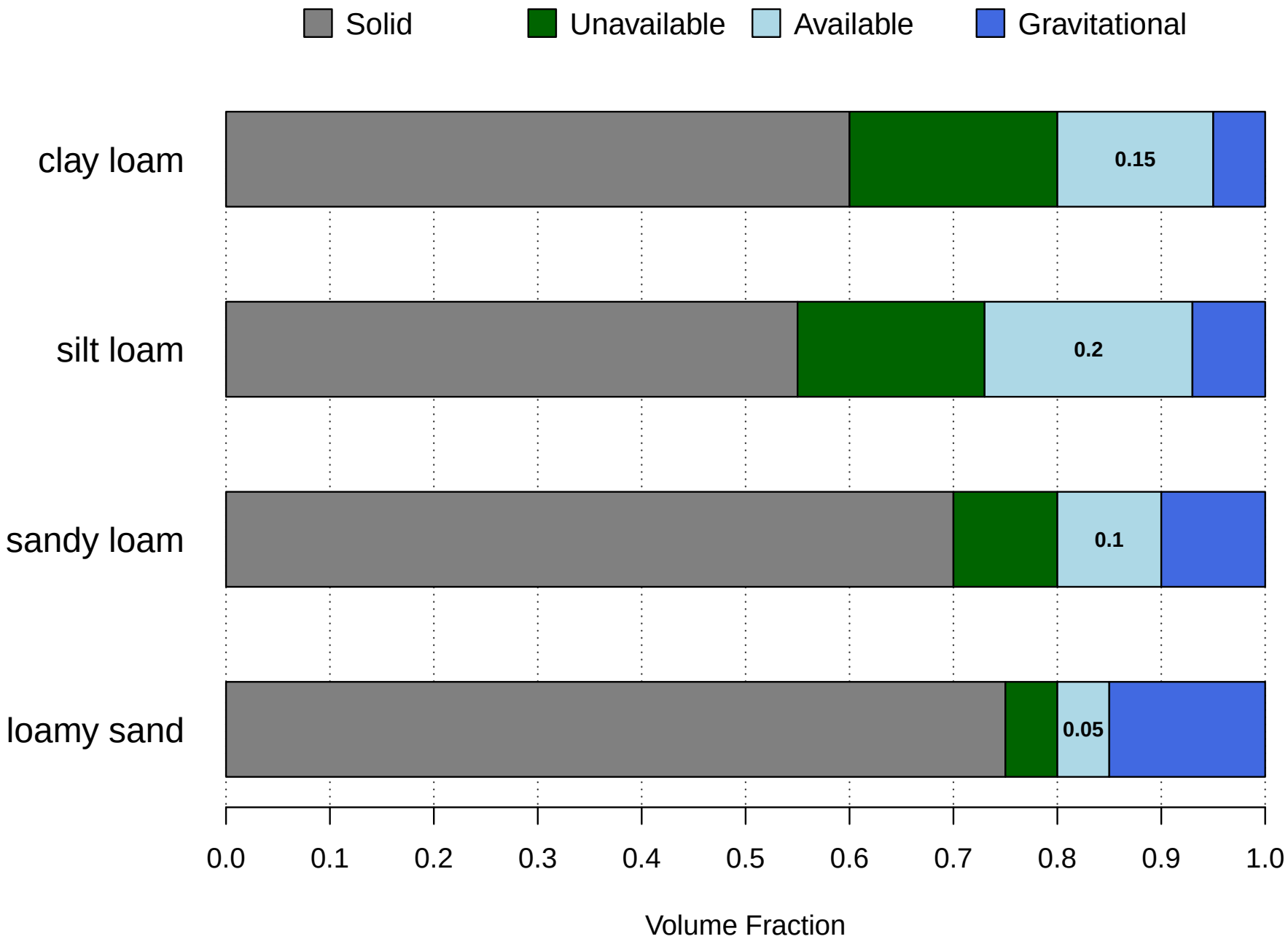
- drainage / residence time $\rightarrow$ lag between precipitation and streamflow
- organic inputs $\rightarrow$ DOC $+$ chlorine $\rightarrow$ carcinogenic precursors
- local slope $+$ soil texture $+$ plant density $\rightarrow$ erosion risk

Soils are complex. Fortunately, there are several "master" parameters that are enough to model the system within a reasonable level of precision.

Water Retention Curve



Sensor Data + Physical Properties: Soil Water Storage



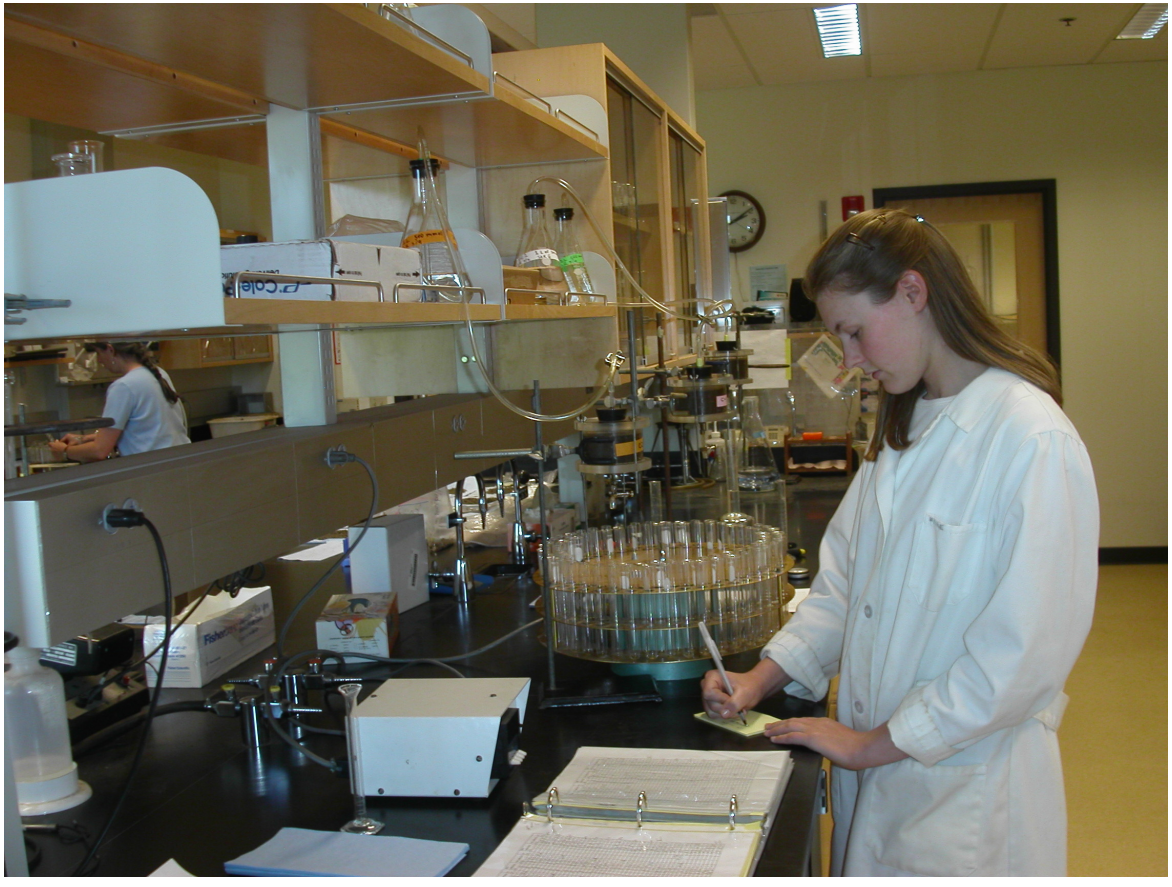
Where Do We Get Soil Data?

Soil is not Dirt

"Soil is a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface, occupies space, and is characterized by one or both of the following: horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or the ability to support rooted plants in a natural environment." –Soil Taxonomy 2nd Ed.

"Man has only a thin layer of soil between himself and starvation." –Bard of Cincinnati

Where Do We Get Soil Data?



Dig holes, describe/sample horizons, and send to a lab for characterization.

Or, use Soil Survey data.

Soils and Landscapes are Tightly Coupled

The Soil Profile

A collection of horizons and associated properties define the soil profile.

Soil Data + Landscape Context = Soil Survey

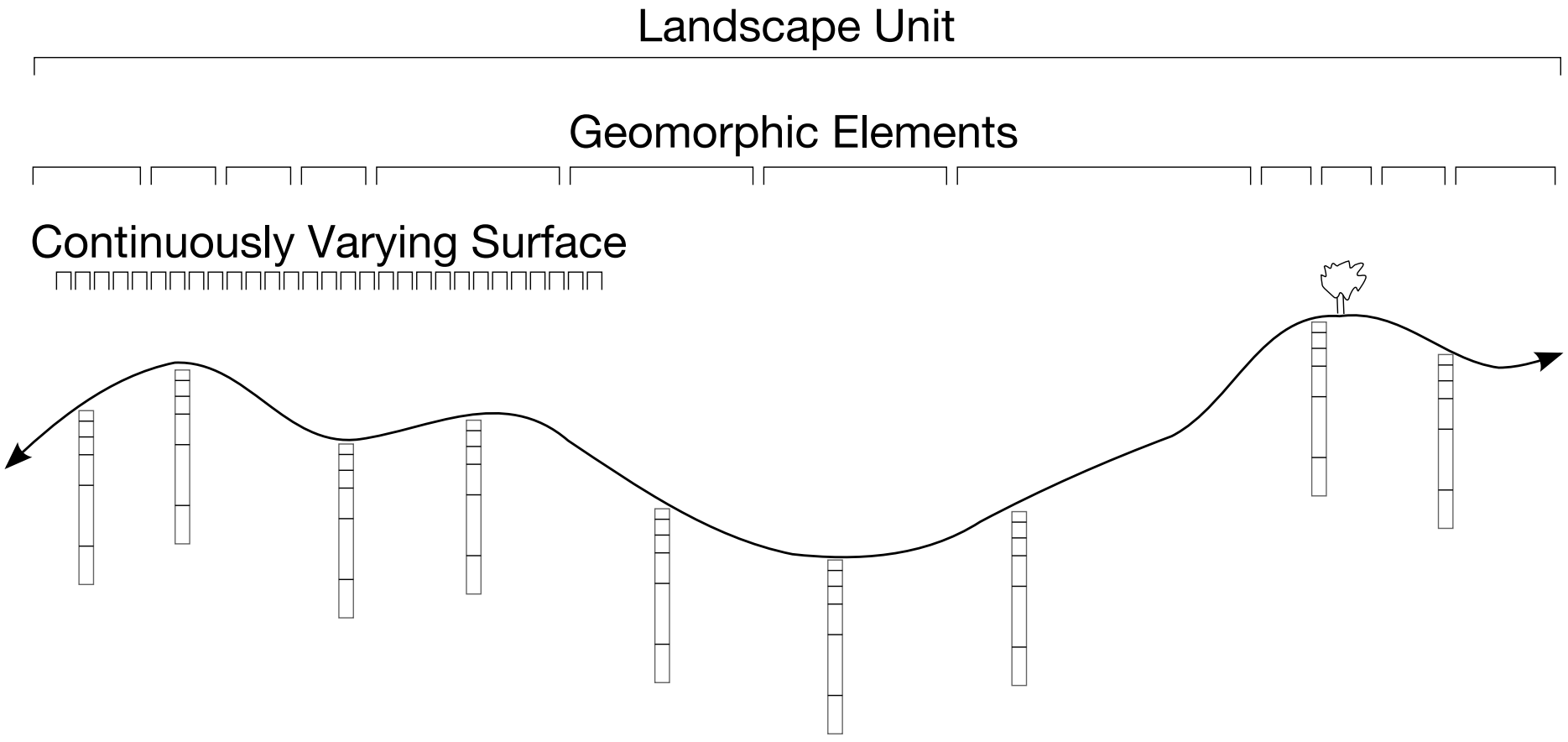
0-8cm **A**
8-25cm **BA**
25-60cm **Bt1**
60-90cm **Bt2**
90-105cm **Cr**
105cm+ **R**

Metabasalt
Ultic Haploxeralfs

0-5cm **A1**
5-10cm **A2**
10-30cm **AB**
30-50cm **Bw**
50-65cm **C**
65cm+ **Cr**

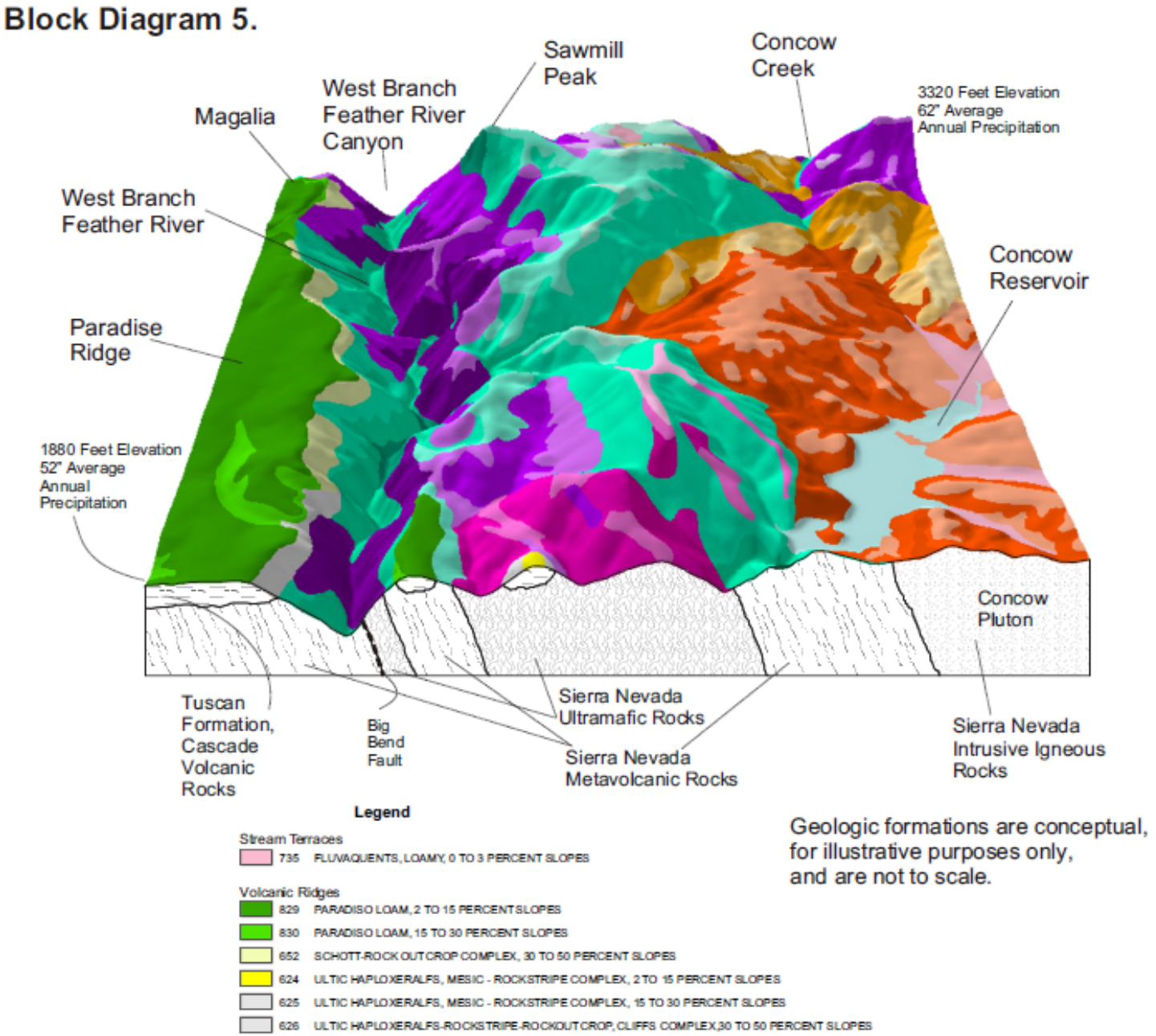
Granodiorite
Typic Xerorthents
Typic Haploxeralfs

Basic Concepts of Soil Survey



- soils are sampled along *suspected* gradients in soil-forming factors:
  $\rightarrow$ climate, vegetation, relief, parent material, age, ...
- soils are mapped by identifying consistent soil $\sim$ environment relationships
- several possible levels of map generalization possible
  $\rightarrow$ topographic complexity, budget constraints, expected usage, etc.

SSURGO: Butte County Example



SSURGO: Limitations and Considerations

Map Unit Design

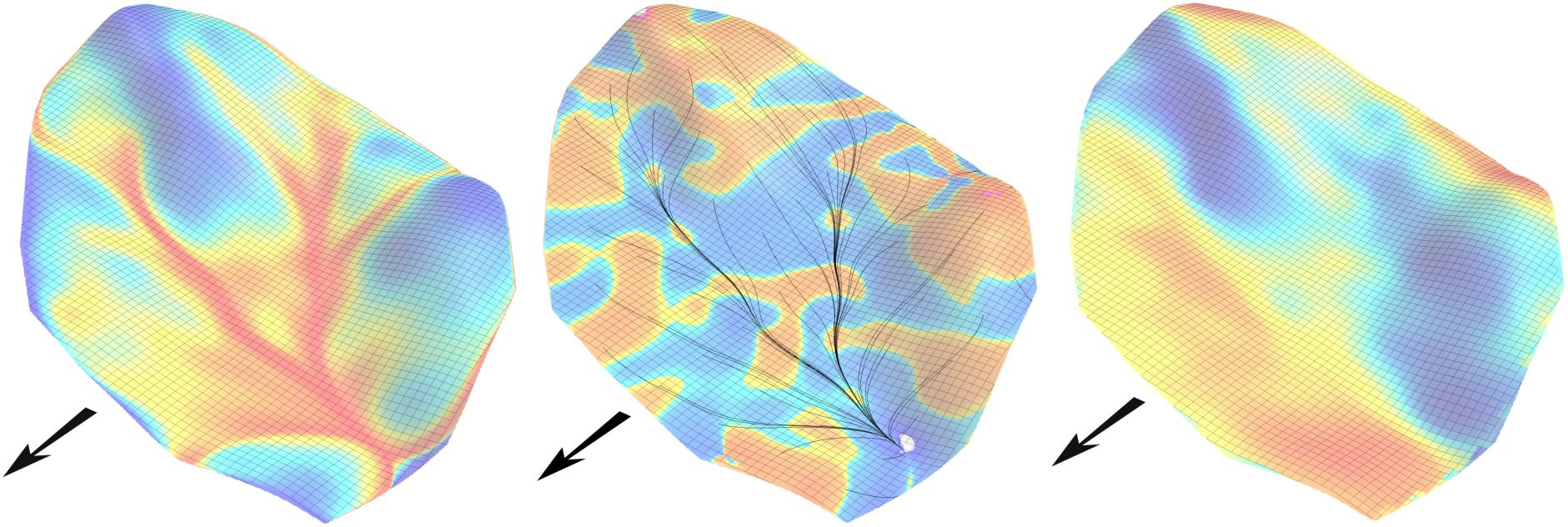
- Any given survey must comply with basic standards, but older surveys reflect a more generalized approach than more modern surveys.
- Polygons represent a repeating pattern of legend entries (map units)
- There is a many:1:many:many (polygon:mapunit:component:horizon) relationship between spatial and horizon-level soil property data.
- Many properties are *estimated* via regression.

Aggregation Notes

- Aggregate horizon data by one of the following methods:
  - top 1m
  - top horizon
  - profile sum
  - depth weighted (mean, median, sd)
  - most limiting
- Aggregate component by one of the following methods:
  - component percent weighted (mean, median, sd)
  - largest component (beware ties)
  - major component flag (beware ties)
  - dominant condition

Future Soil Survey: Refinement via Terrain Analysis

- Compound indices of relative landscape position → **CTI**
- Indices of local convergence/divergence → **surface curvature**
- Quantitative descr. of soil microclimate → **modeled solar radiation**



These are all related to local **soil climate**.

Thank You

Online Resources:

- USDA-NRCS Soils: `http://soils.usda.gov`
- Web Soil Survey: `http://websoilsurvey.nrcs.usda.gov/`
- Soil Data Access: `http://sdmdataaccess.nrcs.usda.gov/`
- SoilWeb: `http://casoilresource.lawr.ucdavis.edu/soilweb/`
- AQP: `http://ncss-tech.github.io/AQP/`